Critical Humanities

Volume 2
Issue 2 *Teaching in the Time of ChatGPT and other forms of AI*

Article 3

January 2024

From Polygraphs to Truth Machines: Artificial Intelligence in Lie Detection

Jo Ann Oravec
University of Wisconsin - Whitewater

Recommended Citation

Oravec, Jo Ann. "From Polygraphs to Truth Machines: Artificial Intelligence in Lie Detection." *Critical Humanities* 2, 2 (2024). DOI: https://doi.org/10.33470/2836-3140.1036

From Polygraphs to Truth Machines: Artificial Intelligence in Lie Detection

Cover Page Footnote
none

From Polygraphs to Truth Machines: Artificial Intelligence in Lie Detection

Jo Ann Oravec
University of Wisconsin, Whitewater

Abstract

The proliferation of artificial intelligence (AI)-enhanced lie detection tools in police, educational, community, and governmental contexts signals a new era of deception detection. With these AI developments, collections of intimate biometric information such as facial and retinal data, keystroke patterns, brain scans, and physiological changes in the cardiovascular system are combined with personal profiles to produce analyses of a subject's supposed veracity. This article explores some early lie detection technologies (such as the polygraph) and discusses the influences that lie detection initiatives have had in human interactions through the decades. It addresses the empirical issues (in the context of police and educational examination applications) of whether specific AI technologies have the capability of recognizing lying along with the related cultural concerns involving the proliferation of lie detection implementations. It analyzes the appropriateness of using invasive and often unreliable new AI methodologies for lie detection in comparison with previous methods such as the polygraph. The article also examines ethical and cultural concerns involving the obtaining and analyzing of such intimate data. It analyzes the subordinate statuses of the human subjects of lie detection as well as issues of consent for those who need to deal with complex and often opaque systems. Whatever the answers to questions about reliability and mental privacy, many AI-enabled lie detection technologies are currently being utilized in security and police procedures, employment interviewing, and anti-cheating educational initiatives.

Jo Ann Oravec (MA, MS, MBA, PhD) is a full professor in the College of Business and Economics at the University of Wisconsin-Whitewater (Department of Information Technology and Supply Chain Management), as well as the Holtz Center for Science & Technology Studies, UW-Madison. Her publications include *Good Robot, Bad Robot: Dark and Creepy Sides of Robotics, AI, and Autonomous Vehicles* (Springer) and *Virtual Individuals, Virtual Groups* (Cambridge University Press). She was the first chair of the Privacy Council of the State of Wisconsin. She was a visiting fellow at Oxford and Cambridge.

Developing methodologies to promote truth-telling has been a perennial and often frustrating challenge for human societies, despite advances in computing, cognitive science, and social engineering. As human endeavors have become more information-intensive, focuses on lie detection have increased.[1] Various strategies have been devised to elicit truthful statements from individuals through the centuries, such as administering oaths and honor codes or imposing threats and sanctions. Compelling human subjects to refrain from fabricating verbal or written statements or engage in academic cheating is often cast in moral terms, with the supposedly heroic efforts of communities and organizations staving off the perceived insubordinate activities of certain individuals. This article examines the social and ethical implications of artificial intelligence (AI) applications for lie detection, comparing AI methods with previous kinds of lie detection procedures such as the polygraph. The societal context involved in these AI applications is important to consider, with many of the applications being ported from police, military, and security arenas into domestic settings. These settings include educational test taking, where proprietary systems such as Proctorio use AI techniques that originated in lie detection applications to monitor students for cheating.[2] This movement is in keeping with the manner in which early lie detection technologies such as the polygraph were transformed from tools used primarily by police to ones with broad applications in employment and even recreational games.[3] I argue that although these recent AI applications apparently make lie-detection processes seem less onerous on their faces than previous lie-detection methods they can put subjects in inferior and often demoralizing positions, opening new concerns about invasive data collection processes and potential biases in the results.

Lie detection technologies such as the polygraph have often been controversial, facing strong criticism for unreliability, bias, and unfairness.[4] However, the perceived ease of implementing AI-related lie detection tools is making them tempting to inject into everyday workplace and community situations such as educational

[1] Andrew S. Balmer, *Lie Detection and the Law: Torture, Technology and Truth*. (New York: Routledge, 2018).

[2] Monica Chin, "University Will Stop Using Controversial Remote-testing Software Following Student Outcry," *The Verge,* January 20, 2021, https://www.theverge.com/2021/1/28/22254631/university-of-illinois-urbana-champaign-proctorio-online-test-proctoring-privacy

[3] John P. Baesler, *Clearer than Truth: The Polygraph and the American Cold War* (Amherst, Massachusetts: University of Massachusetts Press, 2018); Jo Ann Oravec, "Promoting Honesty in Children, or Fostering Pathological Behaviour? Emerging Varieties of Lie Detection Toys and Games," *M/C Journal* 26, no. 3 (2023).

[4] Jessica Kurland, "Abracadabra, Hocus Pocus, Same Song, Different Chorus: The Newest Iteration of the Science of Lie Detection." *Richmond Journal of Law & Technology,* 24, no. 1 (2017): 1-35.

examinations as well as in job interviews.[5] These AI innovations affect the roles and responsibilities of the human testing administrators and agents involved in lie detection, as described in sections to come. I contend that AI developments in lie detection may undermine the efforts to establish trust and personal autonomy in many societal contexts by creating pervasive yet often unreliable lie detection initiatives, sometimes labeled as "truth machines," such as those described in recent scientific articles.[6] These developments can make lie detection efforts nearly impossible to notice for the subject, since remote collection of data is involved and relatively few data points are needed for the AI-powered analysis.

The persistence of lie detection technologies as a factor in movies, television shows, and true crime novels has bolstered the reputation of lie detection despite many documented problems.[7] Many individuals have already had personal experience with eye-scanning, facial recognition, and related lie detection applications in their international travels and academic examinations.[8] Lie detection today has extensive applications including the post-conviction surveillance of sex offenders in the US and of potential sick leave falsifiers in other nations.[9] Mayoral et al. describe the use of lie detection technologies in theft investigation of employees in some US businesses.[10] This article focuses on the negative aspects of using AI methodologies in lie detection, which is a sensitive domain that involves the personal integrity of

---

[5] Christopher Harding, "Selecting the Ethical Employee: Measuring Personality Facets to Predict Integrity Behaviour," Doctoral dissertation, Carleton University, 2019; Steven Melendez, "Goodbye Polygraphs: New Tech Uses AI to Tell If You're Lying," *Fast Company*, 2018, https://www.fastcompany.com/40575672/goodbye-polygraphs-new-tech-uses-ai-to-tell-if-youre-lying

[6] Kento Tsuchiya, Ryo Hatano, and Hiroyuki Nishiyama. "Detecting deception using machine learning with facial expressions and pulse rate." *Artificial Life and Robotics* (2023): 1-11. https://doi.org/10.1007/s10015-023-00869-9

[7] Jörg Mecke, *Cultures of Lying: Theories and Practice of Lying in Society, Literature, and Film* (Madison, Wisconsin: Galda & Wilch, 2007).

[8] Douglas Heaven, "AI to Interrogate Travellers," *New Scientist*, 240, no. 3202 (2018); Louise M. Jupe and David A. Keatley, "Airport Artificial Intelligence Can Detect Deception: Or Am I Lying?" *Security Journal*, 24 (2020):1-4.

[9] Don Grubin, "Post-Conviction Polygraph Testing of Sex Offenders," *International Review of Psychiatry*, 31, no. 2 (2019):141-148; Michael J. Stathis and Michael M. Marinakis, "Shadows into Light: The Investigative Utility of Voice Analysis with Two Types of Online Child-Sex Predators," *Journal of Child Sexual Abuse*, 29, no. 1 (2020):1-22. doi:10.1080/10538712.2019.1697780; Philip H. Witt and David J. Neller, "Detection of Deception in Sex Offenders," *Clinical Assessment of Malingering and Deception* (4th ed.), edited by Richard Rogers and Scott D Bender, The Guilford Press, 2018, 401–421.

[10] Luis Pascual Cordero Mayoral et al., "The Use of Polygraph Testing for Theft Investigation in Private Sector Institutions," *Polygraph*, 46, no. 1 (2017): 44 -52.

individuals as well as the reputations of the communities and organizations involved. In this article, I draw on the literature of AI research, which has strong linkages with cognitive science and encompasses a wide and diverse range of technological approaches from logic-based to machine learning.[11] A limitation of this article is that it mainly uses US and UK examples to illustrate its arguments; Alder identifies a long-standing "obsession" of the US with lie detection devices.[12] Other nations have also shown interest or resistance to lie detection technology, such as China[13] and Saudi Arabia.[14]

Catching Lies and Subordinating Humans

The basic notion of a lie is critical to the consideration of lie detection technology's applications. For the purposes of this article, a "lie" is a specific type of dishonesty, placed within a social context in which speech acts are given certain weights and framings. Lies can arise "to capitalize on instrumental gains, avoid losses, build or maintain relational bonds"[15] as well as to succeed in various recreational gaming situations such as card games in which not revealing one's cards is essential for success. A widely-accepted definition of the term "lie" is a false statement made by an individual who is aware that the statement is probably not true.[16] This characterization underscores the volitional nature of a lie, recognizing that not only must liars make a false statement but also be convinced of the statement's falsity, though the extent of this belief can indeed vary. Rhetoric about the harms of telling lies is common in Western societies, although the distinctions between fabrication and reality are increasingly becoming blurred in an era of virtual reality and other data manipulation tools. Telling lies on the part of individuals has heavy moral sanctions while the fact that many organizations as a whole can be rife with deceptive efforts is less frequently questioned.

Lie detection technologies generally place subjects in physically and socially subordinate positions, with their subsequent well-being and reputation contingent upon the operation of the lie detection apparatus. For example, as described in the next section, polygraph equipment is literally

[11] Robert Domanski, "The AI Pandorica: Linking Ethically-Challenged Technical Outputs to Prospective Policy Approaches," *Proceedings of the 20th Annual International Conference on Digital Government Research,* ACM Press, 2019, 409-416.
[12] Ken Alder, *The Lie Detectors: The History of an American Obsession.* (Omaha, Nebraska: University of Nebraska Press, 2009).
[13] Xiaoyu Zhang, "The Evolution of Polygraph Testing in the People's Republic of China," *Polygraph*, 40, no. 3 (2011): 181-193.
[14] A. Ayoub et al., "The Polygraph and Lie Detection: A Case Study," *Arab Journal of Forensic Sciences & Forensic Medicine,* 1, no. 7 (2018): 902-908.
[15] Christian L. Hart, Jelisa M. Jones, John A. Terrizzi Jr, and Drew A. Curtis. "Development of the Lying in Everyday Situations Scale," *The American Journal of Psychology* 132, no. 3 (2019): 343.
[16] Thomas Carson, "The Definition of Lying," *Noûs* 40, no. 2 (2006): 284-306.

strapped to human subjects and test administrators are placed in dominating locations in relation to subjects. Polygraphs capture data on abdominal and thoracic respirations as well as cardiovascular and electrodermal indicators with the use of physically-attached sensors. With AI-enabled processes, subordination can take on an even stronger turn, framing the subject as being scrutinized and evaluated by a supposedly super-intelligent AI entity, one that is often invisible to the subject. Data can be collected remotely from facial recognition devices and voice analysis as well as keyboard stroke analysis (as outlined in an upcoming section). In the process of lie detection, information supposedly relating to an individual's mood or intent can be gleaned[17] with the inner workings of the subject's mentality supposedly exposed by the apparatus. Much of the published research pertaining to lie detection so far has been conducted in the realm of crime, although recent efforts have expanded these efforts dramatically, targeting such arenas as employment interviewing, sports, and education.[18] Use of AI-enhanced lie detection technologies (originally developed for crime-related contexts) in educational settings has expanded with concerns about students cheating as they use their personal laptops to work on examinations or otherwise engage in remote work. Facial recognition techniques, keyboard stroke analysis, and other AI-supported biometric methods have been used to identify potential academic cheating incidents, although the technologies applied have not been fully validated.[19]

AI methodologies are gaining substantial reputations for their power in many societal arenas,[20] so it is not surprising that they are being integrated into lie detection processes. Fears that AI will somehow be disruptive or even destructive in its capacities have emerged since its inception in the 1950s.[21] Current anxieties about AI somehow having the power to upset society as a whole are being expressed in everyday news media discourse, such as Pope Francis' pronouncement about potential disruptions related to AI and computer networking (Fung, 2023). The kinds of anxieties associated with AI in the realm of lie

---

[17] G. S. Monisha et al., "Enhanced Automatic Recognition of Human Emotions Using Machine Learning Techniques," *Procedia Computer Science* 218 (2023): 375-382.

[18] Chris Engler and Geoffrey Schweizer. "'Are You Telling the Truth?'—Testing Individuals' Ability to Differentiate Between Truth and Deceit in Soccer." *Frontiers in Psychology* 11 (2020). https://doi.org/10.3389/fpsyg.2020.01082

[19] Jo Ann Oravec, "AI, Biometric Analysis, and Emerging Cheating Detection Systems: The Engineering of Academic Integrity?" *Education Policy Analysis Archives* 30, no. 175 (2022).

[20] Luciano Floridi, "Establishing the Rules for Building Trustworthy AI," *Nature Machine Intelligence*, 1, no. 6 (2019): 261-262, https://www.nature.com/articles/s42256-019-0055-y

[21] Frank Pasquale, *The Black Box Society* (Cambridge, Massachusetts: Harvard University Press, 2015).

detection are more personal and perhaps "creepier" than these broader concerns about the fate of humanity. The capability (albeit unproven) to detect lying often places AI-enhanced lie detection tools in a perceived position of superiority over their subjects, even to the point of being able to "read minds" of humans to an extent that is sometimes considered magical (Balmer 2018). In past decades, the polygraph was often considered with comparable levels of hype (as related in the next section), which allowed polygraphy to be misused in many real-life settings as well as in fictional productions. Voluntary uses of lie detection technologies are abundant in workplace contexts, for example in attempts to support one's innocence if accused of workplace malfeasance (Iacono and Patrick 2018), which demonstrates the trust many people still place in these unproven technologies. Also, despite the fact that many students have expressed concerns about the use of AI-enabled applications such as Proctorio to monitor their test taking, most still submit to the procedures.[22]

From Polygraph "Third Degree Tactics" to AI Invasiveness

Traditional polygraphy has played major roles in framing lie detection processes through the past decades, establishing a legacy for ensuing AI efforts. Polygraphy is "use of a physiological measurement apparatus with the explicit aim of identifying when someone is lying. This typically comes with specific protocols for questioning the subject, and the output is graphically represented."[23] The polygraph "measures galvanic skin response, blood pressure, heart and breathing rates, and perspiration as a proxy for nervous-system activity (primarily anxiety) as an (imperfect) proxy for deception."[24] "Leakages" of various physiological cues (especially relating to movements in the eyes, lips, and hands) can apparently signal increased levels of anxiety on the part of the subject, and thus are often utilized in lie detection. However, leakages are not foolproof in providing the information needed for accurate results, since some individuals can modify their leakages either through training or because of various psychological conditions such as psychopathy.[25]

[22] Chin, "University Will Stop Using Controversial Remote-testing Software."
[23] Lisanne Bergers, "Only in America? A History of Lie Detection in the Netherlands in Comparative Perspective, ca .1910 -1980." Master's thesis, Utrecht University, the Netherlands, 2018, 1.
[24] Amanda McAllister, "Stranger than Science Fiction: The Rise of AI Interrogation in the Dawn of Autonomous Robots and the Need for an Additional Protocol to the UN Convention against Torture," *Minnesota Law Review*, 101 (2017): 2527, https://scholarship.law.umn.edu/mlr/180
[25] Vincent Denault and Norah E. Dunbar, "Credibility Assessment and Deception Detection in Courtrooms: Hazards and Challenges for Scholars and Legal Practitioners," *The Palgrave Handbook of Deceptive Communication,*

Brutal-appearing aspects of polygraph administration have been portrayed in many fictional movies and television shows as well as formal academic and legal characterizations:

> … the examination requires that the subject be seated and physically constrained by blood pressure cuffs, chest tubes and electrical leads. The subject has presumably consented to this. However, many subjects who are asked by the police to take a polygraph test will feel pressure to comply ("If you say you're innocent, what do you have to fear?")… For all their denunciations of police brutality, then, the lie detector still functioned as what August Vollmer candidly called "a modified, simplified and humane third degree."[26]

Along with the seeming severity of "third degree" polygraph practices, lie detectors were often used for demeaning "fun and games" even before they were made more widely available to the public. An assortment of gender-related comparisons and displays were conducted in the past century with polygraphs, in part for entertainment purposes as well as for research; women subjects were often portrayed in provocative and even titillating poses along with polygraph machines.[27] In Chicago in 1932, a couple exchanged marriage vows while strapped to a lie detector at Northwestern University; in effect they affirmed their faith in the technology as well as to each other. An inventor of some polygraphic iterations, John Larson, reportedly "found his future wife while testing the machine on control groups of pretty coeds. Yes, he asked if she liked him when she was strapped to the machine."[28] Although polygraph administration experts were generally involved in applying the technology for serious purposes, the apparatus was often designed so that police officers could utilize it in everyday crime investigations. An early polygraph designer, Leonarde Keeler, "made the lie detector into an instrument that almost anyone could operate, even a minimally trained police officer, but because of the way he conceived of its operation, it actually enhanced the discretionary power of the examiner, who was less interested in the polygraph record per se than in using the process to intimidate the subject."[29] Polygraphs often became expressive tools for police and security agents, giving their administrators dramatic props for use in their crime-fighting and disobedience-

---

edited by Timothy R. Levine (New York: Palgrave Macmillan, 2019), 915-935.

[26] Ken Alder, "To Tell the Truth: The Polygraph Exam and the Marketing of American Expertise," *Historical Reflections/Réflexions Historiques* 24, no. 3 (1998): 512

[27] Geoffrey C. Bunn, "Supposing that Truth Is a Woman, What Then?": The Lie Detector, the Love Machine, and the Logic of Fantasy," *History of the Human Sciences*, 32, no. 5 (2019):135-163, doi:10.1177%2F0952695119867022

[28] Jon M. Sands, "The Lie Detectors: The History of an American Obsession," *Jurimetrics*, Vol. 49, No. 2 (2009): 246.

[29] Alder, "To Tell the Truth: The Polygraph Exam."

detection contexts whatever the technologies' reliability and validity.

From the 1950s to the 1980s, polygraphs were often used in workplace settings for comparably intimidating and occasionally vicious purposes, practices that were eventually restrained by legislative effort for many industries in the UK and US.[30] The requirement that individuals be physically strapped or otherwise attached to a lie detection apparatus has limited the variety of applications in which traditional polygraphy could play a part. Notable exceptions include the US Army's Preliminary Credibility Assessment Screening Systems (PCASS), which are handheld polygraphs that are still in use for on-the-field lie detection.[31] Efforts to evaluate polygraph systems in some formal manner have been problematic: for example, polygraphs are often evaluated with actors playing liars, which can make the process conceptually troubled since the quality of the acting involved can be at issue.

The popularity of lie detection technologies has continued through the decades in police and military venues despite various attacks on their usefulness and reliability. Lie detection technologies played strong roles in Cold War security efforts, providing a sense that the "truth" could be extracted from captured spies and suspected traitors. However, some academic and public policy leaders have also opposed lie detection proliferation. For example, some commentators identify lie detection as "little more than a racket."[32] Along comparable lines, In an analysis of the use of lie detection for sex offenders, Laws characterizes lie detection efforts as "the bogus pipeline to the soul"[33] and Fischer disparages them as being akin to the mind reading tricks of magicians.[34] The emergence of AI strategies have reinforced the acceptance and proliferation of lie detection approaches especially in the contexts of police and educational initiatives. AI technologies include a wide and growing assortment of methodologies, including pattern matching, profiling, and ontology construction,[35] all of which are used in various lie detection applications, as described in the following section.

[30] Baesler, *Clearer than Truth: The Polygraph and the American Cold War*.
[31] Alistair L. MacNeill and Michael T. Bradley, "Temperature Effects on Polygraph Detection of Concealed Information," *Psychophysiology,* 53, no. 2 (2016):143 -150.
[32] Matt Stroud, *Thin Blue Lie: The Failure of High-tech Policing* (Metropolitan Books, 2019), 17.
[33] D. Richard Laws, *A History of the Assessment of Sex Offenders :1830 -2020* (New York: Emerald Publishing Limited, 2020).
[34] Lisa Fischer, "The Idea of Reading Someone's Thoughts in Contemporary Lie Detection Techniques," *Mind Reading as a Cultural Practice,* edited by Laurence Petit and Manuela Saltao Fernandes Silva (New York: Palgrave Macmillan, 2020), 109-137.
[35] Shikha Khatri, et al., "Impact of Artificial Intelligence on Human Resources," *Data Management, Analytics and Innovation,* edited by Utku Kose et al. (New York: Springer, 2020), 365-376.

AI-Enhanced Lie Detection Techniques

Use of AI techniques in arenas with such complex implications for individuals as lie detection can present various ethical as well as practical challenges. For example, the *EyeDetect* system "administers a 30-minute test judging truthfulness bas ed on a computer's observations of eye movement"[36] which has been used to investigate whether individuals stole an item or cheated on an examination. Since the quality and quantity of eye movements can have cultural variations, biases can result in *EyeDetect's* application. Output from *EyeDetect* was accepted as evidence by courts, though many judges have been reluctant participants in this arena. *EyeDetect's* applications in police as well as civilian venues include the following:

> Converus' technology, *EyeDetect*, has been used by FedEx in Panama and Uber in Mexico to screen out drivers with criminal histories, and by the credit-ratings agency Experian, which tests its staff in Colombia to make sure they aren't manipulating the company's database to secure loans for family members. In the U.K., police are carrying out a pilot scheme that uses *EyeDetect* to measure the rehabilitation of sex offenders. Other *EyeDetect* customers include the government of Afghanistan, McDonald's, and dozens of local police departments in the United States.[37]

One of the recent approaches of AI researchers in the lie detection arena is to develop a growing "corpora" of training examples for use in constructing and fine-tuning their machine learning applications. The kinds of examples that are utilized to train AI applications are selected to support or represent to some extent the problem area in question. For example, Takabatake, Shimada, and Saitoh constructed a "Liar Corpus" that collects various human expressions in situations that reportedly involve prevarication.[38] Unfortunately, forms of bias can be introduced as items are selected for these training corpora that are skewed in various

[36] Steven Melendez, "Goodbye Polygraphs: New Tech Uses AI to Tell If You're Lying," *Fast Company*, 2018, para. 7., https://www.fastcompany.com/40575672/goodbye-polygraphs-new-tech-uses-ai-to-tell-if-youre-lying

[37] Amit Katwala, "The Race to Create a Perfect Lie Detector- and the Dangers of Succeeding," *The Guardian*, September 5, 2019, para. 2., https://www.theguardian.com/technology/2019/sep/05/the-race-to-create-a-perfect-lie-detector-and-the-dangers-of-succeeding

[38] Shuhei Takabatake, Katsuhiko Shimada, and Tetsuya Saitoh, "Construction of a Liar Corpus and Detection of Lying Situations," *2018 Joint 10th International Conference on Soft Computing and Intelligent Systems (SCIS) and 19th International Symposium on Advanced Intelligent Systems (ISIS)* (New York: IEEE Press, 2018), 971-976.

dimensions, such as race or gender.[39] Training data are often generated through social media scraping, crowdsourcing, and other processes that can introduce racial, ethnic, or gender biases in ways that may not be obvious to administrators or users of the systems.[40]

Below are several more dimensions of how AI enhancement can alter the character of lie detection strategies:

Role of human administrators:

According to Gonzalez-Billandon, AI-enhanced systems have changed the role of human agents in lie detection efforts.[41] The human agent is often able to play a less obvious and visible role than with traditional polygraphs. This change in the functions of the agent presents the potentials for more autonomous and less transparent lie detection. For example, the students who are taking an exam with Proctorio are not directly aware of what the system is noticing in terms of their facial expressions, hand movements, or other input.[42] Although a number of skilled individuals may indeed be required to run the AI-enhanced system involved, they generally do not play comparably direct, interactive roles with the subject than in previous kinds of lie detection systems.

Remote, unobtrusive, and invasive collection of subjects' data:

The capabilities of AI-enhanced systems have made it possible to collect data remotely and unobtrusively, yet invasively. With some of the AI-enhanced data collection systems, efforts at fakery are made more difficult because of the uncertainty about how, when, and what data are being collected. Through machine learning techniques, patterns can be found in these various forms of data that were not previously predictable either by the lie detection subject or system administrator. The modes for assimilating data for lie detection analysis have increasingly extended far beyond bulky sensors and also include instruments that collect data without the subject's close proximity. For instance, wearable technologies, eye scanning, and webcams are being used to collect the data used for anti-deception initiatives (as with Converus Corporation's *EyeDetect*). Respiration rate detectors that do not require physical contact with subjects have also been developed. Other kinds of data sources are emerging such as eye blinking patterns; cognitive load considerations have also been integrated into some

[39] Mahdiyeh Hashemi and Mark Hall, "Criminal Tendency Detection from Facial Images and the Gender Bias Effect," *Journal of Big Data*, 7, no.1 (2020).
[40] Eszter Hargittai, "Potential Biases in Big Data: Omitted Voices on Social Media." *Social Science Computer Review* 38, no. 1 (2020): 10-24.
[41] Jose Gonzalez-Billandon et al., "Can a Robot Catch You Lying? A Machine Learning System to Detect Lies during Interactions," *Frontiers in Robotics and AI*, 6, no. 64 (2019):1-12, doi:10 .3389/frobt.2019.00064
[42] Oravec, "AI, Biometric Analysis, and Emerging Cheating Detection Systems."

systems in which the individuals' mental tasks are increased in ways that may reveal prevarication patterns. Analyses of these sets of complex data can be made feasible through the pattern discovery of AI machine learning systems. Invasive approaches such as fMRI are also providing new, complex data sources that can require machine learning and big data analytical capabilities to interpret, potentially decreasing the transparency and openness of the systems involved.[43] Some corporations have performed fMRI-based lie detection operations for more than a decade although scientific support for their use is still emerging.[44]

Subject profiling and the individuation of lie detection:

Profiling individuals (with the inclusion of demographic and behavioral information into analyses) has been utilized to improve lie detection.[45] Predictive approaches can stem from such efforts to individuate, posing questions of whether the integrity-related behavior of individuals can (or should) be forecast. The possibilities for development of rosters of "potential liars" in various contexts is all too apparent; these rosters could result in reputational harm and decreased life opportunities for those listed. For young people who have been "caught cheating" (perhaps in error), the reputational damage from being placed in such a list can be immense. Accumulation of personalized "integrity scores" or other ways of profiling individuals over time in terms of their supposed propensity to lie has become a part of some recent research initiatives and technological development strategies in lie detection.[46] Applications of the AI-enhanced methods and algorithms involved may indeed have particularly negative outcomes for individuals with certain combinations of demographic characteristics. Since these lie detection technologies are often used in security, wartime, and international border crossing contexts, such variations can be especially problematic in terms of human rights.

With AI approaches, some lie detection researchers are developing complex constructs such as "micro-expressions" or "micro-gestures" that would be difficult for those with limited technological support to utilize or challenge. In the case of micro-expressions, machine learning capabilities for analyzing large amounts of data about facial expressions have been designed to determine which subtle facial changes and combinations of physical cues are associated with lying. Barathi asserts that these supposedly unconscious micro-

---

[43] Giuseppe La Tona et al., "Lie Detection: fMRI," *Radiology in Forensic Medicine,* edited by Giuseppe Lo Re et al., (New York: Springer, 2020), 197-202.

[44] Kurtis G. Haut, Taylan Sen, Denis Lomakin, and Ehsan Hoque. "A Mental Trespass? Unveiling Truth, Exposing Thoughts, and Threatening Civil Liberties With Noninvasive AI Lie Detection," *IEEE Transactions on Technology and Society* 3, no. 2 (2022): 132-142.

[45] Rita Singh, *Profiling Humans from Their Voice* (Singapore: Springer, 2019).

[46] Harding, "Selecting the Ethical Employee."

expressions are "involuntary reaction[s] that are impossible to fake"[47] and are thus especially useful in lie detection efforts. Consider the following scenario involving *Silent Talker,* an early effort to incorporate AI into lie detection analysis:

> The *Silent Talker* consists of a digital video camera that is hooked up to a computer. It runs a series of programs called artificial neural networks… The camera records the subject in an interview and the artificial brain identifies non-verbal 'micro-gestures' on people's faces. These are unconscious responses that Silent Talker picks up on to determine if the interviewee is lying. Examples of micro-gestures include signs of stress, mental strain and what psychologists call 'duping delight'. This refers to the unconscious flash of a smile at the pleasure and thrill of getting away with telling a lie… One can imagine a near-future scenario… where every micro-gesture that "leaks" from your face is a response that flashes by [prospective employers'] eyes as "true" or "false" in real-time.[48]

Some border control efforts have recently segregated certain micro-expressions as "biomarkers of deceit," stirring some controversy and protest in part because of potential bias in their selection and implementation.[49]

Many aspects of AI applications have been questioned as to their transparency, with algorithms and processes that are not readily interpretable for humans, especially in the realm of machine learning.[50] Rules for building transparent and "trustworthy" AI[51] are still emerging and basic security issues have yet to be resolved in many data capture and neuroscience arenas.[52] This provides additional complications for system implementers as they struggle to provide some semblance of security provisions in organizational contexts. The possibility of returning to the polygraph as a major means for lie

[47] C.S. Barathi, "Lie Detection Based on Facial Micro Expression, Body Language and Speech Analysis," *International Journal of Engineering Research & Technology*, 5, no. 2 (2016): 337.

[48] Paul Kennedy, "Artificial Intelligence Lie Detector Developed by Imperial Alumnus," Imperial College London, 2014, para. 5-8, https://www.imperial.ac.uk/news/144486/artificial-intelligence-detector-developed-imperial-alumnus/

[49] Javier Sánchez-Monedero and Lina Dencik, "The Politics of Deceptive Borders: 'Biomarkers of Deceit' and the Case of iBorderCtrl," *Information Communication & Society*, 23, no.14 (2020): 2144-2161.

[50] B.S. Barn et al., "Mapping the Public Debate on Ethical Concerns: Algorithms in Mainstream Media," *Journal of Information Communication and Ethics in Society*, 18, no .1 (2019): 124-139. doi:10 .1108 /JICES-04-2019-0039

[51] Floridi, "Establishing the Rules for Building Trustworthy AI."

[52] Omer Landau et al., "Mind Your Mind: EEG-Based Brain-Computer Interfaces and Their Security in Cyber Space," *ACM Computing Surveys (CSUR*), 53, no. 1 (2020).

detection has been considered, given security and other concerns.[53] Issues of whether certain AI and cognitive science techniques are superior to the polygraph (which has served as a standard for lie detection for nearly a century) have often served as a benchmark for evaluating the systems in question. Bryant (2018) asks whether such AI-enhanced technologies will "replace the polygraph."[54] In comparable terms, Meijer and Verschuere address whether lie detection with neuroimaging or "brain scanning" using fMRI (functional magnetic resonance imaging) is "better" than the polygraph.[55] The social and cultural backings for lie detection technologies have varied in intensity, but their century-long roots in favorable film, television, and science fiction depictions of polygraphs and related technologies have had a powerful and sustained influence.[56]

Future AI Lie Detection Initiatives and Potential Societal Impacts

The potential for perpetual, autonomously-controlled lie detection systems (or "truth machines") to become part of everyday community and organizational practices looms large for the future. AI tools such as facial recognition, voice analysis, and keyboard stroke analysis can be used without alerting the subjects involved, operating without the subject's recognition or permission. Establishment of autonomous, AI-enhanced lie detection apparatuses that are widely implemented could replace many of the more human-level and nuanced aspects of traditional lie detection, substituting the polygraph technician in a white coat with a pervasive, all-seeing presence.

Eagerness for AI-enhanced approaches as potential solutions to problems involving honesty may affect the judgment of researchers and administrators concerning the effectiveness and appropriateness of the resulting systems. For example, research on potential neuroscientific lie detection applications has often been presented with an optimistic tone, with confident assessments including "One day cognitive neuroscientists might perform the magic of accurate mind reading."[57] Recent neuroscientific initiatives are working to expand the range of lie detection and even move toward direct cognitive manipulation in which the ways that individuals think in various contexts could be

---

[53] Paul Bryant, "Will Eye Scanning Technology Replace the Polygraph?" *Government Technology*, December 21, 2018, http://www.govtech.com/public-safety/Will-Eye-Scanning-Technology-Replace-the-Polygraph.html

[54] Bryant, "Will Eye Scanning Technology Replace the Polygraph?"

[55] Ewout H. Meijer and Bruno Verschuere,"Deception Detection Based on Neuroimaging: Better than the Polygraph?" *Journal of Forensic Radiology and Imaging*, 8 (2017): 17

[56] Geoffrey C. Bunn, "Supposing that Truth Is a Woman, What Then?": The Lie Detector, the Love Machine, and the Logic of Fantasy," *History of the Human Sciences*, 32, no. 5 (2019):135-163, doi:10.1177%2F0952695119867022

[57] Jonathan A. Moreno, "The Future of Neuroimaged Lie Detection and the Law," *Akron Law Review*, 42 (2009): 717 -737.

considerably influenced.[58] Maréchal et al. proposes ways to "increase honesty in humans with noninvasive brain stimulation," thus supposedly reducing the need for lie detection by decreasing the propensity to lie.[59]

Lie detection introduces extraordinarily intimate and sensitive issues when primarily conducted with AI agents, who are often perceived as somehow "superintelligent" in their capabilities, and less easily challenged by their subjects.[60] Being investigated by a human interrogator who interprets human leakage for clues can be construed as substantially different from interactions with an AI-based agent, the output of which is less often questioned.[61] The support that lie detection technologies are afforded in many cultures makes it difficult for individuals to dispute specific findings or contest the use of le detection practices as a whole. The growing investments in AI-enhanced applications by communities and organizations can make resistance to lie detection efforts even more difficult.

Dystopian scenarios involving mental privacy, bias, and fairness can readily emerge from technological projections of lie detection technologies. Mental privacy deals with "people's right and ability to keep private what they think and feel."[62] Many of the AI-enhanced lie detection systems described in this article have generated mental privacy concerns in relation to their data collection approaches.[63] For example, the remote lie detection data collection initiatives described in the previous section raise knotty issues about surreptitious data collection procedures and can complicate related organizational efforts to obtain informed consent. Brain scanning presents new challenges as well in this arena, imposing invasive data collection: the prospect that one's supposedly-private mental processes will be open to forms of scanning as an aspect of one's educational or employment situation presents human rights concerns.[64] These

[58] Ryan R. Darby and Alvaro Pascual-Leone, "Moral Enhancement Using Non-Invasive Brain Stimulation," *Frontiers in Human Neuroscience*, 11 (2017): 77-91, doi:10.3389/fnhum.2017 .00077

[59] Michel A. Maréchal et al., "Increasing Honesty in Humans with Noninvasive Brain Stimulation," *Proceedings of the National Academy of Sciences*, 114, no. 17 (2017): 4360-4364.

[60] Fischer, "The Idea of Reading Someone's Thoughts"; Simone Natale, "Amazon Can Read Your Mind: A Media Archaeology of the Algorithmic Imaginary," *Believing in Bits: Digital Media and the Supernatural,* edited by Simone Natale and Diana Pasulka (Oxford University Press, 2019), 19-36; Russell A. Poldrack, *The New Mind Readers: What Neuroimaging Can and Cannot Reveal About Our Thoughts* (Princeton University Press, 2018).

[61] Mayoral, "The Use of Polygraph Testing for Theft Investigation."

[62] Lambèr Royakkers et al., "Societal and Ethical Issues of Digitization," *Ethics and Information Technology*, 20, no. 2 (2018): 130.

[63] Erika L Wright, "The Future of Facial Recognition Is Not Fully Known: Developing Privacy and Security Regulatory Mechanisms for Facial Recognition in the Retail Sector," *Fordham Intellectual Property Media & Entertainment Law Journal,* 29 no. 2 (2018): 611-685.

[64] Brian Farrell, "Can't Get You Out of My Head: The Human Rights Implications of

processes have the prospect to infringe on the autonomy of individuals' self-representations,[65] with the subjects involved not having control or even knowledge of how their thoughts are being represented.

Mental privacy plays roles in human rights in affording individuals with adequate space to manifest personal autonomy and express themselves adequately in various situations. Mental privacy can also be construed as having organizational paybacks as well as benefits for employees, fostering the development of autonomous individuals capable of critical thinking. Although traditional polygraphs are problematic in terms of privacy, the fact that their operations take place with the conscious awareness of the subject makes their operations less opaque and more comprehensible. Some analysts have identified the "sanctity of the mind" as an important notion to defend for the purposes of reinforcing individual autonomy.[66] Despite the dangers involved, many researchers are still apparently drawn to the "seductive allure" of neurotechnology and related AI-enhanced lie detection efforts in real-life organizational applications.[67]

The problem of bias has been associated with an assortment of AI-enhanced systems, including facial recognition as well as lie detection.[68] The quality of training data has been identified as one of the primary ways that AI-enhanced lie detection systems can produce biased results, although the machines can be faulty because of intentional misprogramming and other causes. Zou and Schiebinger state that "Most machine-learning tasks are trained on large, annotated data sets… such methods can unintentionally produce data that encode gender, ethnic and cultural biases."[69] These data sets are often scraped from various social media and other Internet sources, generally by outsourcers; HR managers may not be able to ascertain the quality of the data utilized. The kinds of biases that have been associated with some AI implementations (such as racial, gender, or disability-related skewing due to inappropriate choice of training data) could indeed have impacts upon how lie

---

Using Brain Scans as Criminal Evidence," *Interdisciplinary Journal of Human Rights Law,* 4 (2009): 89-95. https://ssrn.com/abstract=1609827.

[65] Jeroen Van den Hoven and Noëmi Manders-Huits, "The Person as Risk, the Person at Risk," *ETHICOMP 2008: Living Working and Learning Beyond Technology*, T.W. Bynum, M.C. Calzarossa, I. De Lotto, & S. Rogerson (Eds.), University of Pavia (2008), 408-414.

[66] Peter B. Reiner and Saskia K. Nagel, "Technologies of the Extended Mind: Defining the Issues," *Neuroethics: Anticipating the Future*, edited by Judy Illes, (Oxford University Press, 2017), 108-122.

[67] Catherine M. Giattino et al., "The Seductive Allure of Artificial Intelligence-Powered Neurotechnology," *Proceedings of the 2019 AAAI /ACM Conference on AI, Ethics, and Society,* ACM Press, 2019, 397.

[68] Fabio Bacchini and Lorenzo Lorusso, "Race, Again: How Face Recognition Technology Reinforces Racial Discrimination," *Journal of Information, Communication and Ethics in Society*, 17, no. 3 (2019): 321-335, doi:10.1108/JICES-05-2018-0050.

[69] James Zou and Londa Schiebinger, "AI Can Be Sexist and Racist-It's Time to Make It Fair," *Nature,* 559 (2018): 325

detection and credibility assessment systems are designed and implemented.[70] Profiles of individuals that are built on these biased results can compound the damages associated with the biases. Efforts to eradicate system-imposed biases and isolate the damages involved can also be complicated by deficits in transparency in machine learning systems, so that debugging of the systems for potential problems is difficult if not impossible in some cases.

Kinds of unfairness associated with AI-enhanced lie detection can diminish the autonomy of individuals and present human rights violations. For example, the prospects of being construed as guilty before having an opportunity to be proven innocent (with its associated unfairness) loom large in lie detection approaches that are rooted in autonomous and non-transparent processes. The use of individuated feedback and personalized profiles that calibrates some AI-enhanced lie detection devices has been linked with the notion of individuals in effect testifying against themselves, engendering calls to expand the "right of silence" to AI-driven interrogation efforts.[71] McAllister describes AI-driven questioning and interviewing as "stranger than science fiction"[72] and recommends related international discussions and agreements concerning human rights.

Lie detection processes have indeed often been problematic through the centuries, as well as directly associated with inhumane practices. Human interrogators have utilized such extreme and physically damaging measures as torture, sleep deprivation, and truth serums to elicit supposedly truthful statements and aid in the detection of lies.[73] The damages involved in using AI-enhanced lie detection technologies described above may not be physically painful but can result in the kinds of reputational and psychological harms that can have lasting impacts on an individual. Some of the mental states of an individual are reportedly exposed as a result of particular lie detection processes, supposedly to the overall benefit of society in which "truth" is a valued commodity.

Consent and Outcome Evaluation for Lie Detection

AI-enhanced lie detection technologies have the potential to transform the relationship between individuals and the technologies they intentionally use or encounter as a part of everyday life. For example, if the system that one uses for specific purposes (such as an examination by an educational institution) is used to assess one's

[70] Shari Trewin et al., "Considerations for AI Fairness for People with Disabilities," *AI Matters*, 5 no. 3 (2019): 40-63, doi:10.1145/3362077.3362086.

[71] Kristen Thomasen, "Examining the Constitutionality of Robot-Enhanced Interrogation," *Robot Law*, edited by Ryan Calo et al. (Edward Elgar Publishing, Northampton, MA, 2016).

[72] McAllister, "Stranger than Science Fiction: The Rise of AI Interrogation."

[73] Alder, *The Lie Detectors.*

motive for using it, an everyday encounter with the system can become an adversarial relationship that involves one's specific bodily and mental postures. Consent issues with AI-enhanced applications are complicated by the fact that the technologies incorporated into the system (such as machine learning) are often opaque, and their operations are nearly impossible to decipher on a human level. Machine learning captures and analyzes input using a set of neural-like connections and interactions that are not directly translatable into human language, bust still capture analyzable patterns.[74]

The many challenges outlined in this paper underscore that the ethical and professional vigilance of researchers, system implementers, and organizational administrators is essential in the face of technological developments at the intersection of AI and lie detection. As these individuals decide which projects to pursue and which technologies to introduce to the market some recognition of the negative impacts of lie detection technologies can help shape organizational research and development priorities.[75] Lie detection and credibility assessment pose especially difficult challenges for scientific evaluation. As previously stated, many of the testing methods for lie detection rely on actors playing the role of liars, since obtaining "real liars" in specific experimental settings is problematic.[76] Some evaluation settings for lie detection compare outcomes with conviction rates, which may entail societal bias issues, as conviction rates can differ based on ethnicity, race, and gender. As a complicating factor, lie detection technologies are often used in tense, multi-dimensional security situations in which many issues and emotions are intertwined.[77] The uncertainties involved can enhance the challenges of AI system implementation, including the lack of understanding of system limitations on the part of many administrators.[78] Minimizing the number of false positives with lie detection should be a priority for ethical organizations, as being falsely accused of lacking integrity can have traumatic and damaging effects on lie detection subjects as well as others involved in the processes. Educational contexts are especially problematic in this regard, since inappropriate charges of academic cheating can have

[74] Poldrack, *The New Mind Readers.*
[75] Tomiwa O. Shevlane and Allan Dafoe, "The Offense-Defense Balance of Scientific Knowledge: Does Publishing AI Research Reduce Misuse?" *Proceedings of the AAAI/ACM Conference on AI Ethics and Society,* 2020, 173-179.
[76] William G. Iacono and Christopher J. Patrick, "Assessing Deception," *Clinical Assessment of Malingering and Deception,* edited by Richard Rogers and Scott D. Bender, 4th ed. (New York: Guilford Publications, 2018).
[77] Galit Nahari et al., "'Language of Lies': Urgent Issues and Prospects in Verbal Lie Detection Research," *Legal and Criminological Psychology*, 24, no.1 (2019): 1-23, doi:10 .1111/lcrp.12148
[78] James Bittle, "Lie Detectors Have Always Been Suspect. AI Has Made the Problem Worse," *Technology Review*, March 13, 2020, https://www.technologyreview.com/2020/03/13/905323 /ai-lie-detectors-polygraph-silent-talker-iborderctrl-converus-neuroid/

extensive psychological and social impacts for students, whether or not they eventually achieve exoneration.

Conclusion

Just a few decades ago, lie detection technologies were largely in the hands of police, military, spies, and other operatives who could wield them openly in demeaning and even sadistic ways, whether or not any lies were supposedly identified. AI is transforming the field of lie detection, moving beyond the apparent limitations of the polygraph but also generating new concerns especially about the transparency and potential pervasiveness of lie detection applications. AI tools such as facial recognition, voice analysis, and keyboard stroke analysis can be used remotely, establishing a pervasive lie detection umbrella that operates without the subject's recognition or consent. Combining these tools with the demographic and behavioral profiling of individuals can make the situation even more daunting. Difficult human rights challenges arise from the use of AI-enhanced lie detection technologies, such as the potential for unfairness, bias, and mental privacy violations. The growing level of hype about the power of AI is a significant factor in how AI applications such as lie detectors are characterized.[79] AI applications are certainly not omniscient, and machine learning systems can have biases based on how they are trained (as related in this paper), so assumptions that the systems are without blemishes can be problematic. Remote data collection and individuated integrity scores and profiles expand the technological possibilities of lie detection. Hype and misunderstandings concerning AI capabilities could also play roles in distorting the human subject's perceptions of the lie detection processes involved, and possibly influence the deterrent capabilities of the systems as well.

Despite the considerable human rights challenges involved, developing widely-accepted lie detection technology is still a major pursuit of many corporate, military, and security agencies, presenting the promise of containing and controlling lying behavior with admittedly-flawed technological systems. Katwala describes the "race to create a perfect lie detector" in organizational settings as incorporating AI approaches.[80] The dangers of such lie detection efforts have been characterized by researchers in the following stark terms: "Robust totalitarianism could be enabled by advanced lie detection, social manipulation, autonomous weapons, and ubiquitous physical sensors and digital footprints."[81] The cognitive manipulation that

[79] Jo Ann Oravec, "Artificial Intelligence, Automation, and Social Welfare: Some Ethical and Historical Perspectives on Technological Overstatement and Hyperbole," *Ethics and Social Welfare* 13, no. 1 (2019): 18-32.

[80] Katwala, "The Race to Create a Perfect Lie Detector."

[81] Allan Dafoe, "AI Governance: A Research Agenda" (Governance of AI Program, Future of Humanity Institute, University of Oxford, August 27, 2018).

results when individuals are forced to conform to the lie detection system's perceived requirements could unfortunately damage mental health as well as have deleterious social impacts. Using technologies that were developed for the realm of crime control in domestic situations such as educational examinations and job interviewing makes for the placement of damaging levels of psychological control on students and interviewees.

Questioning the very purpose of lie detection technologies may be futile in many contexts, given how solidly they have been injected into the cultures of some Western nations through popular treatment in films and television shows as well as real-life applications by the police. From the polygraph to today's AI-enhanced systems, lie detection technologies have been designed for the subjugation of individuals, placing the promotion of perceived "honesty" above human autonomy and dignity. AI enhancements to lie detection systems have often made the systems seem less intrusive to their subjects but also increase challenges to human rights through their invasiveness and lack of transparency. A preferable strategy to promote truth-telling would have organizations, communities, and societies supporting the establishment of trust and mutual respect among participants rather than fostering problematic and stress-inducing systems.

References

Alder, Ken. "To Tell the Truth: The Polygraph Exam and the Marketing of American Expertise." *Historical Reflections/Réflexions Historiques* 24, no. 3 (1998): 487-525.

Alder, Ken. *The Lie Detectors: The History of an American Obsession.* University of Nebraska Press, 2009.

Ayoub, A., et al. "The Polygraph and Lie Detection: A Case Study." *Arab Journal of Forensic Sciences & Forensic Medicine,* 1, no. 7 (2018): 902-908.

Bacchini, Fabio, and Lorenzo Lorusso. "Race, Again: How Face Recognition Technology Reinforces Racial Discrimination." *Journal of Information, Communication and Ethics in Society*, 17, no. 3 (2019): 321-335, doi:10.1108/JICES-05-2018-0050.

Balmer, Andrew S. *Lie Detection and the Law: Torture, Technology and Truth*. Routledge, 2018.

Baesler, John P. *Clearer than Truth: The Polygraph and the American Cold War.* University of Massachusetts Press, 2018.

Barathi, C.S. "Lie Detection Based on Facial Micro Expression, Body Language and Speech Analysis." *International Journal of Engineering Research & Technology*, 5, no. 2 (2016): 337-343.

Bard, Jennifer S. "Ah Yes, I Remember It Well: Why the Inherent Unreliability of Human Memory Makes Brain Imaging Technology a Poor Measure of Truth-Telling in the Courtroom." *Oregon Law Review,* 94 (2015): 295-332.

Barn, B.S., Balbir S., et al. "Mapping the Public Debate on Ethical Concerns: Algorithms in Mainstream Media." *Journal of Information Communication and Ethics in Society*, 18, no .1 (2019): 124 -139. doi :10 .1108 /JICES -04 -2019 -0039

Bergers, Lisanne. "Only in America? A History of Lie Detection in the Netherlands in Comparative Perspective, ca .1910 -1980." Master's thesis, Utrecht University, the Netherlands, 2018.

Bittle, James. "Lie Detectors Have Always Been Suspect. AI Has Made the Problem Worse." *Technology Review*,13 Mar. 2020. https://www.technologyreview. .com/2020/03/13/905323 /ai-lie-detectors-polygraph-silent-talker-iborderctrl-converus-neuroid/

Bryant, Paul. "Will Eye Scanning Technology Replace the Polygraph?" *Government Technology*, 21 Dec. 2018, http://www.govtech.com/public-safety/Will-Eye-Scanning-Technology-Replace-the-Polygraph.html

Bunn, Geoffrey C. “Supposing that Truth Is a Woman, What Then?”: The Lie Detector ,the Love Machine, and the Logic of Fantasy." *History of the Human Sciences*, 32, no. 5 (2019):135-163. doi:10.1177%2F0952695119867022

Burgoon, Judee K. "Separating the Wheat from the Chaff: Guidance from New Technologies for Detecting Deception in the Courtroom." *Frontiers in Psychiatry*, 9 (2019): 774 -780. doi:10.3389 /fpsyt.2018.00774

Carson, Thomas L. "The Definition of Lying." *Noûs* 40, no. 2 (2006): 284-306.

Chin, Monica. “University Will Stop Using Controversial Remote-testing Software Following Student Outcry.” *The Verge,* 20 Jan. 2021. https://www.theerge.com/2021/1/28/22254631/university-of-illinois-urbana-champaign-proctorio-online-test-proctoring-privacy

Dafoe, Allan. "AI Governance: A Research Agenda." Governance of AI Program, Future of Humanity Institute, University of Oxford, 27 Aug. 2018.

Darby, Ryan R., and Alvaro Pascual-Leone. "Moral Enhancement Using Non-Invasive Brain Stimulation." *Frontiers in Human Neuroscience*, 11 (2017): 77-91. doi:10.3389 /fnhum.2017 .00077

Denault, Vincent, and Norah E. Dunbar. “Credibility Assessment and Deception Detection in Courtrooms: Hazards and Challenges for Scholars and Legal Practitioners.” *The Palgrave Handbook of Deceptive Communication,* edited by Timothy R. Levine, Palgrave Macmillan, 2019, 915-935.

Domanski, Robert. “The AI Pandorica: Linking Ethically-Challenged Technical Outputs to Prospective Policy Approaches.” *Proceedings of the 20th Annual International Conference on Digital Government Research,* ACM Press, 2019, 409-416.

Englert, Chris, and Geoffrey Schweizer. ""“Are You Telling the Truth?”—Testing Individuals’ Ability to Differentiate Between Truth and Deceit in Soccer." *Frontiers in Psychology* 11 (2020).https://doi.org/10.3389/fpsyg.20 20.01082

Farrell, Brian. “Can’t Get You Out of My Head: The Human Rights Implications of Using Brain Scans as Criminal Evidence.” *Interdisciplinary Journal of Human Rights Law,* 4 (2009): 89-95.https://ssrn.com/abstract=1609827.

Fischer, Lisa. “The Idea of Reading Someone’s Thoughts in Contemporary Lie Detection Techniques.” *Mind Reading as a Cultural Practice,* edited by Laurence Petit and Manuela Saltao Fernandes Silva, Palgrave Macmillan, 2020, 109-137.

Floridi, Luciano. "Establishing the Rules for Building Trustworthy AI." *Nature Machine Intelligence*, 1, no. 6 (2019): 261-262. https://www.nature.com/articles/s42256-019-0055-y

Fung, B. "Pope Francis warns about AI's dangers." *CNN,* 9 Aug. 2023. https://www.cnn.com/2023/08/09/tech/pope-francis-ai/index.html

Giattino, Catherine M. et al. "The Seductive Allure of Artificial Intelligence-Powered Neurotechnology." *Proceedings of the 2019 AAAI /ACM Conference on AI, Ethics, and Society,* ACM Press, 2019, 397-402.

Gonzalez-Billandon, Jose, et al. "Can a Robot Catch You Lying? A Machine Learning System to Detect Lies during Interactions." *Frontiers in Robotics and AI*, 6, no. 64 (2019):1-12. doi:10 .3389/frobt.2019.00064

Grubin, Don et al. "Post-Conviction Polygraph Testing of Sex Offenders." *International Review of Psychiatry*, 31, no. 2 (2019):141-148.

Hargittai, Eszter. "Potential Biases in Big Data: Omitted Voices on Social Media." *Social Science Computer Review* 38, no. 1 (2020): 10-24.

Harding, Christopher D. "Selecting the Ethical Employee: Measuring Personality Facets to Predict Integrity Behaviour." Doctoral dissertation Carleton University, 2019.

Hart, Christian L., Jelisa M. Jones, John A. Terrizzi Jr, and Drew A. Curtis. "Development of the Lying in Everyday Situations Scale." *The American Journal of Psychology* 132, no. 3 (2019): 343-352.

Hashemi, Mahdiyeh, and Mark Hall. "Criminal Tendency Detection from Facial Images and the Gender Bias Effect." *Journal of Big Data*, 7, no.1 (2020).

Haut, Kurtis G., Taylan Sen, Denis Lomakin, and Ehsan Hoque. "A Mental Trespass? Unveiling Truth, Exposing Thoughts, and Threatening Civil Liberties With Noninvasive AI Lie Detection." *IEEE Transactions on Technology and Society* 3, no. 2 (2022): 132-142.

Heaven, Douglas. "AI to Interrogate Travellers." *New Scientist*, 240, no. 3202 (2018).

Iacono, William G., and Christopher J. Patrick. "Assessing Deception." *Clinical Assessment of Malingering and Deception,* edited by Richard Rogers and Scott D. Bender, 4th ed., Guilford Publications, 2018.

Jupe, Louise M., and David A. Keatley. "Airport Artificial Intelligence Can Detect Deception: Or Am I Lying?" *Security Journal*, 24 (2020):1-4.

Katwala, Amit. "The Race to Create a Perfect Lie Detector- and the Dangers of Succeeding." *The Guardian*, 5 Sep. 2019.https://www.theguardian.com/technology/2019/sep/05/the-race-to-create-a-perfect-lie-detector-and-the-dangers-of-succeeding

Kennedy, Paul. "Artificial Intelligence Lie Detector Developed by Imperial Alumnus." Imperial College London, 2014. https://www.imperial.ac.uk/news/144486/artificial-intelligence-detector-developed-imperial-alumnus/

Khatri, Shikha, et al. "Impact of Artificial Intelligence on Human Resources." *Data Management, Analytics and Innovation,* edited by Utku Kose et al., Springer, 2020, 365-376.

Kleinberg, Bennett, et al. "Detecting Deceptive Intentions: Possibilities for Large-Scale Applications." *The Palgrave Handbook of Deceptive Communication,* edited by Timothy R. Levine, Palgrave Macmillan, 2019, 403-427.

Kurland, Jessica. "Abracadabra, Hocus Pocus, Same Song, Different Chorus: The Newest Iteration of the Science of Lie Detection." *Richmond Journal of Law & Technology,* 24, no. 1 (2017): 1-35.

La Tona, Giuseppe, et al. "Lie Detection: fMRI." *Radiology in Forensic Medicine,* edited by Giuseppe Lo Re et al., Springer, 2020, 197-202.

Landau, Omer, et al. "Mind Your Mind: EEG-Based Brain-Computer Interfaces and Their Security in Cyber Space." *ACM Computing Surveys (CSUR*), 53, no. 1 (2020).

Laws, D. Richard. *A History of the Assessment of Sex Offenders:1830 -2020.* New York: New York: Emerald Publishing Limited, 2020.

McAllister, Amanda. "Stranger than Science Fiction: The Rise of AI Interrogation in the Dawn of Autonomous Robots and the Need for an Additional Protocol to the UN Convention against Torture." *Minnesota Law Review*, 101 (2017): 2527-2573.https://scholarship.law-umn.edu/mlr/180

MacNeill, Alistair L. and Michael T. Bradley. "Temperature Effects on Polygraph Detection of Concealed Information." *Psychophysiology,* 53, no. 2 (2016):143 -150.

Maréchal, Michel A. et al. "Increasing Honesty in Humans with Noninvasive Brain Stimulation." *Proceedings of the National Academy of Sciences*, 114, no. 17 (2017): 4360-4364.

Mayoral, Luis Pascual Cordero et al. "The Use of Polygraph Testing for Theft Investigation in Private Sector Ins-

titutions." *Polygraph*, 46, no. 1 (2017): 44 -52.

Mecke, Jörg. *Cultures of Lying: Theories and Practice of Lying in Society, Literature, and Film*. Madison, Wisconsin: Galda & Wilch, 2007.

Meijer, Ewout H., and Bruno Verschuere. "Deception Detection Based on Neuroimaging: Better than the Polygraph?" *Journal of Forensic Radiology and Imaging*, 8 (2017): 17-21.

Melendez, Steven. "Goodbye Polygraphs: New Tech Uses AI to Tell If You're Lying." *Fast Company*, 2018. https://www.fastcompany.com/40575672/goodbye-polygraphs-new-tech-uses-ai-to-tell-if-youre-lying

Monisha, G. S., et al. "Enhanced Automatic Recognition of Human Emotions Using Machine Learning Techn iques." *Procedia Computer Scie nce* 218 (2023): 375-382.

Moreno, Jonathan A. "The Future of Neuroimaged Lie Detection and the Law." *Akron Law Review*, 42 (2009): 717 -737.

Nahari, Galit, et al. "'Language of Lies ': Urg ent Issues and Prospects in Verbal Lie Detection Research." *Legal and Criminological Psychology*, 24, no.1 (2019): 1-23. doi:10 .1111/lcrp.12148

Natale, Simone. "Amazon Can Read Your Mind: A Media Archaeology of the Algorithmic Imaginary." *Believing in Bits: Digital Media and the Supern atural,* edited by Simone Natale and Diana Pasulka, Oxford University Press, 2019, 19-36.

Oravec, Jo Ann. "Artificial Intelligence, Automation, and Social Welfare: Some Ethical and Historical Perspectives on Technological Overstatement and Hyperbole." *Ethics and Social Welfare* 13, no. 1 (2019): 18-32.

Oravec, Jo Ann. "AI, Biometric Analysis, and Emerging Cheating Detection Systems: The Engineering of Academic Integrity?" *Education Policy Analysis Archives* 30, no. 175 (2022).

Oravec, Jo Ann. "Promoting Honesty in Children, or Fostering Pathological Behaviour? Emerging Varieties of Lie Detection Toys and Games." *M/C Journal* 26, no. 3 (2023).

Pasquale, Frank. *The Black Box Society*. Harvard University Press, 2015.

Poldrack, Russell A. *The New Mind Readers: What Neuroimaging Can and Cannot Reveal About Our Thoughts.* Princeton University Press, 2018.

Reiner, Peter B., and Saskia K. Nagel. "Technologies of the Extended

Mind: Defining the Issues." *Neuroethics: Anticipating the Future*, edited by Judy Illes, Oxford University Press, 2017, 108-122.

Royakkers, Lambèr, et al. "Societal and Ethical Issues of Digitization." *Ethics and Information Technology*, 20, no. 2 (2018): 127-142.

Sánchez-Monedero, Javier, and Lina Dencik. "The Politics of Deceptive Borders: 'Biomarkers of Deceit' and the Case of iBorderCtrl." *Information Communication & Society*, 23, no.14 (2020): 2144-2161.

Shevlane, Tomiwa O., and Allan Dafoe. "The Offense-Defense Balance of Scientific Knowledge: Does Publ ishing AI Research Reduce Misuse?" *Proceedings of the AAAI/ACM Conference on AI Ethics and Society,* 2020, 173-179.

Singh, Rita. *Profiling Humans from Their Voice.* Springer, Singapore, 2019.

Stathis, Michael J., and Michael M. Marinakis. "Shadows into Light: The Investigative Utility of Voice Analysis with Two Types of Online Child-Sex Predators." *Journal of Child Sexual Abuse*, 29, no. 1 (2020): 1-22. doi:10.1080/10538712.2019.1697780

Stroud, Matt. *Thin Blue Lie: The Failure of High-tech Policing*. Metropolitan Books, 2019.

Takabatake, Shuhei, Katsuhiko Shimada, and Tetsuya Saitoh. "Construct ion of a Liar Corpus and Detection of Lying Situations." *2018 Joint 10th International Conference on Soft Computing and Intelligent Systems (SCIS) and 19th International Symposium on Advanced Intelligent Systems (ISIS),* IEEE Press, 2018, 971-976.

Thomasen, Kristen. "Examining the Con stitutionality of Robot-Enhanced Interrogation." *Robot Law*, edited by Ryan Calo et al., Edward Elgar Publishing, Northampton, MA, 2016.

Trewin, Shari, et al. "Considerations for AI Fairness for People with Disabilities." *AI Matters*, 5 no. 3 (2019): 40-63. doi:10.1145/3362077.3362086.

Tsuchiya, Kento, Ryo Hatano, and Hiroyuki Nishiyama. "Detecting deception using machine learning with facial expressions and pulse rate." *Artificial Life and Robotics* (2023): 1-11. https://doi.org/10.1007/s10015-023-00869-9

Van den Hoven, Jeroen, and Noëmi Manders-Huits. "The Person as Risk, the Person at Risk." *ETHICOMP 2008: Living Working and Learni*

ng Beyond Technology, T.W. Bynum, M.C. Calzarossa, I. De Lotto, & S. Rogerson (Eds.), University of Pavia (2008), 408-414.

Witt, Philip H., and David J. Neller. "Detect ion of Deception in Sex Offende rs." *Clinical Assessment of Maling ering and Deception* (4th ed.), edi ted by Richard Rogers and Scott D Bender, The Guilford Press, 2018, 401–421.

Wright, Erika L "The Future of Facial Recognition Is Not Fully Known: Developing Privacy and Security Regulatory Mechanisms for Fac ial Recognition in the Retail Sect- or." *Fordham Intellectual Prope- rty Media & Entertainment Law Journal,* 29 no. 2 (2018): 611-685.

Zhang, Xiaoyu. "The Evolution of Polyg- raph Testing in the People's Republic of China." *Polygraph*, 40, no. 3 (2011): 181-193.

Zou, James, and Londa Schiebinger. "AI Can Be Sexist and Racist-It's Time to Make It Fair." *Nature,* 559 (2018): 324-326.